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Spruce Budworms
Program

Newsletter

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Spruce Budworm Management Requires an Eye to the Future

Note: Here is another view of the joint Vermont-Forest Service demonstration project, reproduced with permission of the editors of *Habitat Highlights*, a publication of the Vermont Fish and Game Department. *Newsletter No. 30* (September 1983) featured a brief article about the project by Dave Grimble of the CANUSA-East staff.

Since 1974, the spruce budworm has been a major forest insect pest in Vermont's Northeast Kingdom, where over 150,000 acres (60 000 ha) of spruce–fir stands have been damaged to date. The Vermont Department of Forests, Parks and Recreation, in cooperation with the USDA Forest Service, has initiated a Spruce Budworm Demonstration Project (SBDP) to show methods of treating spruce–fir stands to reduce damage from, and susceptibility to, budworm outbreaks.

In July, Greensboro was the site of two SBDP training sessions for public and private foresters, wildlife biologists, and area landowners. Presentations were made on the biology of the insect, current research, damage assessment techniques, utilization of budworm-damaged timber, and the impact of budworm outbreaks on wildlife resources, particularly deer winter range. Field trips were led by Ross Morgan and Rich Carbonetti, consulting foresters, to generate discussions on planned or completed cutting practices within spruce–fir stands that also provide winter shelter for deer.

Figure 1. Spruce budworm sixth-instar larvae take lunch on a twig of balsam fir. (Photo courtesy of ***Habitat Highlights****.)*

One site visited was a 20-acre (8-ha) spruce–fir stand, lightly infested by budworm, owned by Dr. Tom Sullivan of Newport. Mature spruce and fir were harvested last winter in groups and small patch cuts, none of which exceeded a quarter acre in size. The small openings created in the forest canopy should stimulate softwood regeneration which will become the future critical winter shelter for deer when the final harvest cut is made in twenty to thirty years.

Deer should still be able to utilize this stand in the near future as adequate patches of cover remain. The basal area of the residual stand ranges from 0 square feet/acre (0 m^2/ha) in the openings to an average of 123 square feet/acre (11.43 m^2/ha) in the uncut areas. A mixture of hardwood browse is expected to become established along with softwoods in the openings, and this will provide a valuable food source for wintering deer. Breaking up the continuity of this stand will hopefully increase budworm larvae dispersal mortality, thereby rendering the stand less susceptible to future budworm damage.

A similar treatment of individual tree and group tree selection was prescribed for another site that was visited. Again, mature spruce and fir trees were removed and openings created for establishment of softwood regeneration, reducing the basal area from 210 to 110 square feet/acre (19.5 to 10.2 m^2/ha). Spruce was favored over fir because it is less susceptible to budworm infestation.

In both cases, commercially marketable trees were left uncut to provide the shade and seed source required for natural softwood regeneration. These residual trees should put on additional diameter growth and increase in timber value.

Fortunately, these stands received silvicultural treatment before budworm defoliation became so heavy as to severely limit timber harvest options. The greatest danger posed by budworm to area deer herds is widespread clearcutting that is often necessary to salvage spruce–fir stands killed by budworm. Large clearcuts, besides eliminating all existing winter shelter, also encourage establishment of pioneer hardwood species which provide no winter cover for deer.

These spruce–fir stands were treated with an eye to the future, and demonstrate it is possible to integrate management options for several different objectives. The Vermont Fish and Game Department commends land managers, such as Mr. Carbonetti and Mr. Morgan, who are able to weigh long-term environmental impacts over short-term economic gain. Such a management philosophy will result in much healthier forests and will improve their timber, wildlife, and aesthetic values.

The Spruce Budworm Demonstration Project will continue to work with private landowners in prescribing silvicultural treatments to combat the budworm. Interested landowners should contact Project Forester Sam Hudson, Department of Forests, Parks and Recreation, Lamoille County Agricultural Center, RFD no. 1, Morrisville, VT 05661.

Cedric Alexander – Vermont Fish &
Game Department
Montpelier, Vermont

Our International Technology Transfer Broadens

Last July, I attended an International Union of Forest Research Organizations (IUFRO) Work Conference in Edinburgh, Scotland. The IUFRO Working Group (S6.08) chose as its theme ''Applying Results of Forest Research.'' Nineteen countries were represented; delegates included many from the less-developed countries.

Papers, which will be published as a proceedings, were diverse, including:

- Two contrasting examples of technology transfer (TT) in eastern Canada
- The Nepal–Australia Forestry Project
- Sustaining the resources of indigenous West African trees
- A research-planning process to assess impacts of air pollutants on forest resources
- Industrial forestry research in the 1980's
- Technology transfer—lessons from the British experience
- The storage, classification, and retrieval of information
- Eruptions applications (communication and TT problems associated with Mount St. Helens)

Students from less-developed countries who had attended a concentrated summer forestry course at Oxford University presented ''situation reports,'' describing forestry research and TT problems in their countries. Reports were on India, Burma, Nepal, Kenya, Uganda, Zambia, Costa Rica, Honduras, Jamaica, Trinidad, Sierra Leone, and Peru. A common theme recurred throughout — constraints to effective technology transfer exist in all countries. Some problems are unique to a particular country, but most are universal.

My own paper, ''Applying research results from 'fringe' disciplines: Lessons learned from integrated pest management R.D. & A. programs,'' presented ''lessons,'' which were unofficially endorsed by the group as applicable but certainly not the whole answer to their problems. Here are my conclusions.

- TT does not just happen, whether the research is from isolated projects or large structured programs; it must be planned from the beginning.
- TT should be continuous during the conduct of the research and after the project or program is over.
- Maximum effort in transfer of technology should be devoted to users, not to the research community; researchers are adequately provided for through the normal publication processes.
- Fringe disciplines, such as entomology and pathology, must learn to present applications of their results in outlets appropriate to users and in an understandable form. Coauthorship with potential users is recommended.
- Success in early transfer depends heavily on the characteristics of the innovation; some new ideas are more complex than others. Hence, a TT plan must be flexible, capable of devoting more effort in training users (if necessary) in the use of complex material.
- Research units must devote particular attention to interaction with units whose primary responsibility is transfer of technology—for example, Forest Pest Management, USDA Forest Service; and extension agents in land-grant universities. Staff for such units should participate in planning and application of research from the outset.
- Once new technology is adopted by opinion molders and decisionmakers, the transfer process cannot be easily controlled. The technology to be transferred must be ready for trial, adoption, or both, before it is espoused too enthusiastically. A failure because of premature release can stop or delay adoption of valuable innovations.
- Although mass media are important in the early stage of TT, the importance of personal contact throughout cannot be overemphasized. Further, in selecting personal contacts, the transferor should consider individual traits and spheres of influence.
- Particular attention must be paid to the form and content of published material for users. A 9-pound book containing all of the information known about an insect is of little value to a forester who needs only guidance in sampling.

— Award systems in research establishments should give appropriate weight to effective transfer of research results to users. (It is ironic that, in most universities, if research produces profitable patents, the rewards to faculty are great. Efforts to implement use of research in the public domain, even if widely adopted, are given little recognition.)

Ron Stark — Program Manager
CANUSA-West
Portland, Oregon

B.T. and the Spruce Budworm - 1983

About fifty forest managers and scientists from government and industry gathered in Fredericton, N.B., September 8, 1983, to attend a seminar on *Bacillus thuringiensis* (B.t.) organized by the New Brunswick Department of Natural Resources. The seminar was designed to provide foresters with an update on the operational use of B.t. against spruce budworm. Speakers from several government agencies and one company reviewed their recent experience with B.t.: Maine (H. Trial, T. Morrison); International Paper (J. Williams); Nova Scotia (T. Smith); New Brunswick (E. Kettela, H. J. Irving); Quebec (J.G. Davidson); and Ontario (G.M. Howse). W.A. Smirnoff of the Laurentian Forest Research Centre, Environment Canada, provided an overview of the recent performance of B.t.

The evolution and development of B.t. has been plagued by comparison with chemical insecticides since serious field testing began about 10 years ago. Conflicting reports relating to effectiveness and cost have definitely hindered acceptance and use of B.t. by forest managers; certainly in New Brunswick these two factors have been the major obstacles to increased use. Because there has been so much conflicting information, the Department of Natural Resources decided to hold a seminar in which speakers from several agencies could compare their experience with B.t. The audience was largely managers from government and industry in New Brunswick, although some attended from as far away as Ontario and Newfoundland. The objective was to provide an accurate information base from which New Brunswick could determine the potential for expanded use of B.t. in the province.

The speakers were asked to address the four major factors that influence choice of insecticide for budworm spraying: 1) cost, 2) effectiveness for foliage protection, 3) operational considerations, and 4) environmental constraints.

Cost

Clearly the cost of B.t. application (aerial application, materials) has been, and continues to be, a major obstacle to more widespread use. One cost component, viz the cost of B.t. products, has declined significantly since 1980. Competitive bidding by the suppliers combined with increasing use in Quebec, Nova Scotia, Ontario, and Maine has forced manufacturers to develop more cost-effective products. Highly concentrated products are now standard and in regular use, resulting in lower unit (BIU) cost, lower shipping costs, and lower finished volumes for application. The average cost per BIU has declined from 68 cents in 1980 to 32 cents in 1983, resulting in reduced insecticide cost per hectare — $6.96/ha ($2.82/acre) to $3.18/ha ($1.28/acre) — in 1983 (Canadian dollars). This decline has occurred despite a general *increase* in application rate from 20 BIU/ha (8 BIU/acre) to 30 BIU/ha (12 BIU/acre). Coincident with this decline has been a steady increase in aerial application cost for *all* pesticides, with the result that the total cost of B.t. application has remained relatively constant over the past 4 years — $27.13/ha ($10.98/acre) in 1980 *vs.* $26.73 ha ($10.82/acre) in 1983.

Of interest is the trend in the cost of B.t. application compared to that of chemicals application. A few years ago, B.t. was generally regarded as being at least three times more costly than chemicals. That differential is diminishing with the stabilizing cost of B.t. and the increasing cost of chemicals. In Maine and Ontario, total B.t. application cost appears to be about 1.5 times more expensive than chemicals, but in New Brunswick and Quebec, B.t. application still costs 2.5 to 3.0 times more than chemicals.

Effectiveness

Although cost data differ significantly from one spray to another, there appears to be a consensus that B.t. works. In the past, B.t. performance was

often reported as being inconsistent, but in 1983, there is surprising agreement among all users that B.t., particularly when applied at 30 BIU/ha (12BIU/acre), provides as good foliage protection on fir and spruce as chemical insecticides. Maine reports surprisingly good results on spruce with better protection than chemicals in many situations. Quebec, one of the largest users, also reports good protection in relation to that achieved with chemicals.

Operational Considerations

The discussion of operational considerations brought out some points which make B.t. use attractive, but also some that make its use more complicated. The safety of B.t. was emphasized, with benefits taking the form of minimum environmental impact and occupational health hazard, no need to carry out costly environmental monitoring programs, and greater public acceptance. Some of the problems encountered included variability in product potency and application characteristics, deterioration of premixed B.t. over time, and the cost of applying higher finished spray volumes. This latter problem is being overcome with the development of concentrated formulations that can be applied neat.

Environmental Constraints

A comparison of environmental constraints imposed by regulatory agencies on the use of B.t. revealed incredible inconsistency in thinking. At one extreme is the State of Maine, which requires no setbacks around habitation, open water, or municipal water supplies, while the Province of Quebec requires a one kilometre setback around habitation, water supplies, and farmland. Such excessive setbacks effectively rule out any protection over very significant forest areas. Inconsistency in setback policies also does little to restore public confidence in the regulatory agencies and user agencies.

The complete proceedings of the seminar are being published, and copies will be available from J. R. Carrow, Department of Natural Resources, P.O. Box 6000, Fredericton, N.B. E3B 5H1.

J. R. Carrow — New Brunswick Department of Natural Resources
Fredericton, New Brunswick.

Burlington Workshop on Monitoring and Evaluating Budworm Populations

More than 50 State and Provincial personnel interested in spruce budworm met in Burlington, Vermont, September 13–15, 1983, to discuss current and new techniques for monitoring budworm populations. The meeting was sponsored by the Vermont Department of Forests and Parks; USDA Forest Service, State and Private Forestry; and CANUSA-East. Canadian and American specialists stressed (1) the importance of monitoring budworm populations; (2) standardization of techniques for ready comparison of data; and (3) use of light traps, pheromone traps, and improved L_2 (soda wash) survey methods. The automated egg-mass counter, under development by the Forest Service's Missoula Equipment Development Center, was discussed at length and its operation demonstrated for the benefit of potential users. Participants also had the opportunity to view a CANUSA video tape produced by the University of Michigan, which presented in layman's terms the silvicultural options available for dealing with severe budworm infestation in Lake States spruce–fir stands.

Although some problems still need to be resolved, the pheromone trapping method seems to be a good bet for future monitoring of low-level budworm populations. Data from three seasons of field trials, gathered by cooperating field personnel in several States and eastern Canadian Provinces, have been compiled and analyzed by coordinators at the State University of New York's College of Environmental Sciences and Forestry, Syracuse. It is now clear that pheromone traps are efficient collectors of male moths. Trap catches may prove to be good indicators of population trends and may eventually even replace egg-mass counts as predictors of the next larval generation.

The final half-day session was devoted to pest management strategies — discussion of actions that owners of small and large properties can take to minimize the potential impacts of future budworm outbreaks; presentation of a theory regarding the origin of past budworm outbreaks; and, finally, a proposal for international cooperation (U.S. and Canada) to anticipate the next budworm outbreak and mitigate its consequences. All of this presumes that the current high budworm populations will soon collapse; not everyone agrees that this will happen in the foreseeable future.

Copies of the proceedings of this workshop will be sent to all attendees and will be available from the USDA Forest Service, Northeastern Forest Experiment Station, 370 Reed Road, Broomall, PA 19008, by early 1984.

Dave Grimble — Applications Coordinator
CANUSA-East
Broomall, Pennsylvania

CANUSANs at the IUFRO Meeting in Banff

Six CANUSA-West investigators participated in a joint meeting of the International Union of Forest Research Organizations at Banff, Alberta, September 4-7, 1983. The meeting combined two working parties, S2.07.05 Population Dynamics and S2.07.06 Integrated Control of Bark Beetles. The theme was "The Role of Host-Pest Interactions in the Population Dynamics of Forest Pests." The following papers about budworm were presented.

"Tree predisposition to insect herbivory — interpretation based on hazard-rating models for the western shoot borer, western spruce budworm, and the Douglas-fir tussock moth." Karel Stoszek and Peter Mika, University of Idaho.

"Predation affects aggregation of the western spruce budworm." R. W. Campbell, USDA Forest Service, Pacific Northwest Forest and Range Experiment Station (PNW); and N. Srivastava, University of Idaho.

"Intertree relations among the western spruce budworm and its natural enemies." R. W. Campbell, PNW.

"Evaluation of techniques for marking a forest insect population with rubidium." J. A. McLean, University of British Columbia.

"Differences in spruce budworm moth catches among types of pheromone traps." R. F. Shepherd, Canadian Forestry Service, Pacific Forest Research Centre.

"Effects of stand characteristics on avian predators of western spruce budworm." E. O. Garton and L. Langelier, University of Idaho.

"Resistance of western spruce budworm in Douglas-fir." G. I. McDonald, USDA Forest Service, Intermountain Forest and Range Experiment Station, Moscow, Idaho.

A related paper was presented by S. Werner, PNW, Fairbanks — "Factors affecting one- and two-year cycle spruce budworm."

Proceedings of the meeting will be published by the Canadian Forestry Service supported by the USDA Forest Service, Washington Office; and CANUSA-West.

CANUSA Budworm Symposium

Planning for the International Symposium continues. Cochairmen Ron Stark and Chris Sanders confirm the following speakers:

1. Biology, Ecology, and Population Dynamics: G. Harvey, R. Blais, R. Shepherd, and J. Volney
2. Economic and Social Impacts: D. MacLean, T. Bible, B. Stocks, and N. Crookston
3. Prevention and Suppression: B. Blum, C. Carlson, J. Armstrong, and J. Cunningham
4. IPM: G. Simmons, W. Cuff, and A. Stage.

This constitutes the framework of the formal program. Moderators have been identified but a few still remain to be confirmed. Applications for 21 posters from the East and 27 from the West have been received to date. The workshop sessions are taking shape and will surely provide an opportunity for all to participate. Meanwhile the editorial staff is making plans for timely publication of the proceedings.

Management has now appointed a Symposium Chairman to coordinate the details of the Symposium — Fred Knight, University of Maine. Please contact him at: College of Forest Resources, University of Maine, Orono, Maine 04469 (Tel.: 207-581-2844).

See you in Bangor on September 17-21.

Some Thoughts On Risk

Here are some comparative risks on the probability of contracting cancer:

- smoking – 1 in 800;
- nonsmoker in same room with smoker – 1 in 100,000;
- one 12 1/2-ounce diet drink per day – 1 in 100,000;
- drinking water at 2 litres per day (some Nova Scotia municipalities) – 1 in 1,000,000;
- four teaspoons of peanut butter per day – 1 in 125,000;
- taking contraceptive pills regularly – 1 in 50,000
- on the other hand the cancer risk of drinking two litres of water directly from a stream immediately after spraying with 2,4-D and 2,4,5-T is 1 in 100,000,000,000 (one hundred thousand million or 100 billion).

The source of this interesting information was the Nova Scotia-herbicide case. The preceding risks were included in Mr. Justice Merlin Nunn's 182-page decision, and were presented to the Court by Dr. Richard Wilson, Chairman of the Department of Physics, Harvard University. An article will be included in the March issue of the *Newsletter*, detailing this case wherein a group of plaintiffs unsuccessfully sought an injunction to restrain Nova Scotia Forest Industries from spraying certain areas of Nova Scotia with herbicides, in particular 2,4–D and 2,4,5–T. Mr Justice Merlin Nunn ruled that proper use of herbicides poses no danger to the public or to the forest environment.

The Use of "Red-Eyed Bees" (*Trichogramma*) in Canadian Forestry

Trichogramma minutum Riley, a small parasitic wasp that attacks the eggs of many important forest insect pests and is known as "red-eyed bees" in China, has received the attention of scientists and biological control managers both inside and outside the Canadian Forestry Service for many years. This small parasite attacks the eggs of the spruce budworm, the forest tent caterpillar, the black-headed budworm, the pine and spruce sawfly complexes, and the shoot moths, as well as those of a host of less important Canadian forest insect pests. Adult parasites are less than 0.5 mm long. They insert their eggs usually singly, into the eggs of the host insects. During warm weather, the wasp's life cycle may be completed in about 10 days and there may be as many as a dozen generations per year. At times, over 75 percent of the pest's eggs are destroyed by the parasite.

Records of the incidence of budworm parasitism by *Trichogramma minutum* have been maintained for its various forest insect hosts by the Forest Insect and Disease Survey (FIDS) since the mid-1940's. However, because egg sampling did not constitute a consistent parameter measurement for any host insect, records were sporadic. Detailed biological studies on the spruce budworm, and to a lesser extent other forest insect pests across the country, indicated that, especially at low to moderate host densities, *Trichogramma* could be an important and perhaps even a key mortality factor. But, natural parasitism was not consistent and could not be depended upon to regulate pest insect populations.

A number of attempts were made, especially against spruce budworm populations during the 1950's, to enhance the natural abundance of *Trichogramma* by releasing additional parasites. The objectives were to provide a self-sustaining and auto-regulating parasite complex to combat the pest. Results were not encouraging because the parasite required substantial numbers of alternate hosts to effectively maintain its population during those extended periods when the pest insect eggs were unavailable. For many years the Biological Control Laboratory of Canada Agriculture was the source of parasites for release, but with the closing of that establishment, the source dried up. Forest Insect and Disease Rangers, FIDS, provided the manpower for the extensive forest releases of *Trichogramma* for almost 20 years.

Recent renewed interest in the use of *Trichogramma* has been fostered by exchanges of Canadian scientists (both from within the CFS and from provincial agencies, specifically Ontario and Quebec) and scientists from the People's Republic of China. Mass production of the parasite, a labor-intensive operation, permits a change of philosophy of control method. Instead of point source releases with the expectation of self-perpetuation, the tactic was changed to inundative releases with no anticipation of carryover from one generation to the next. The parasite in effect has become a biological and very mobile insecticide with little or no prospect of continued impact on the host pest beyond the year of release.

Because the parasites are very costly to produce in large numbers, the tactic is currently not cost-effective. An inundative release program carried out jointly by the CFS (Great Lakes Forest Research Centre) and the Province of Ontario has given a low measure of success. The University of Guelph is the source of the parasites where it has been demonstrated that massive rearings can be made, although extremely expensively.

This tactic is also being explored by the Laurentian Forest Research Centre cooperating with the Province of Quebec, and by the Pacific Forest Research Centre in cooperation with the Province of British Columbia. All are currently watching with interest the results of the Ontario experiments.

Les Reed Leaves CFS

F. L. C. (Les) Reed, who was Assistant Deputy Minister of the Canadian Forestry Service, left the service of the Canadian government in October 1983 to return to private industry. Mr. Reed was appointed as ADM, Forestry in August 1980 with the mission to direct the CFS and coordinate federal policies toward promoting better resource management and forest industry development. Mr. Reed has accomplished that mission, and his strong leadership and motivation will be sorely missed by the CFS. Until the appointment of his successor, Richard Herring has assumed the position of Acting Assistant Deputy Minister of the Canadian Forestry Service.

Personnel

Last October 19, the Society of American Foresters honored one of its own — Ron Stark, Program Manager for CANUSA-West. Ron received the Barrington Moore Memorial Award for 1983 in recognition of his biological research contributing to the advancement of forestry.

Figure 2. Ron Stark and the Barrington Moore Memorial Award. (Photo courtesy of USDA Forest Service, Pacific Northwest Forest and Range Experiment Station.)

The award nomination reviews Ron's career as scientist, teacher, and administrator, and highlights his contributions to the development of integrated pest management. Besides his 120 publications and pioneering research, Ron has played a major role in research and development programs on the mountain pine beetle and Douglas-fir tussock moth, and of course the western spruce budworm.

The *Newsletter* extends its thanks to Dorothy Bergstrom, of the Pacific Northwest Forest and Range Experiment Station staff, who snapped this shot of Ron with his plaque.

CANUSA-East Research Coordinator Bob Talerico has left the Forest Service fold. As part of the winddown of the Program, Bob was transferred to the Northeastern Forest Experiment Station's lab in Orono, Maine. This move would have meant uprooting his family and taking one child out of high school just before her senior year. Bob elected early retirement and is presently at home in Cheshire, Connecticut, wondering what to do with several dozen CANUSA T-shirts. To help him find a new home for these stunning can-of-worms shirts, get in touch with the Program at Dave Grimble's office in Broomall, FTS 489–3016 or (215) 461–3016.

Items from the Press

Budworm infestation worsens. — An infestation of western spruce budworm has spread over an additional 700,000 acres, state and federal foresters say. The infestation, which had been restricted to eastern Oregon, has spread to the Mount Hood National Forest in the Cascade Mountains and now covers about 2.4 million acres of Oregon timberlands, the State Department of Forestry reported.

The U.S. Forest Service, Oregon State Forestry Department, and U.S. Bureau of Land Management have launched an environmental analysis to determine if another aerial spray campaign against the budworm should be undertaken next spring.

State and federal officials sprayed about 528,000 acres last spring in a $5.2 million project that was marred by helicopter crashes and insecticide spills. The worst accident was a June 13 spill of 1,900 gallons of the pesticide Sevin into Willow Creek, resulting in one of the largest insecticide–related fish kills in Oregon history.

In 1982, nearly 180,000 acres of eastern Oregon timberlands were sprayed. The Forest Service said the 1982–83 spray programs will reduce timber volume losses by an estimated 350 million board feet over one rotation of the treated stands.

(United Press International)
October 11, 1983

Budworm problem not over yet.—The western spruce budworm infestation in eastern Oregon's Blue Mountains is continuing to get attention from state and federal officials. The Forest Service's Pacific Northwest Region, the Oregon State Department of Forestry, and the Bureau of Land Management (BLM) are beginning preparation of an environmental analysis of the budworm problem.

The analysis team will review development of the present infestation and the accomplishment of past control measures. In addition, the team will analyze issues raised by the public and other information obtained in consultation with private and public organizations and individuals. The team expects to complete its analysis and development of management alternatives by February 1984.

The affected area involves forested land in Baker, Union, Umatilla, Morrow, Grant, Harney, Wheeler, Jefferson, and Crook Counties. Most of the infestation is on private land and the Wallowa–Whitman, Umatilla, Malheur, and Ochoco National Forests.

The current infestation in the Blue Mountains began in 1980, with significant observable damage recorded in 1981 on 300,000 acres. The infestation rapidly expanded to cover more than 1.6 million acres by late 1982.

Two major control projects were completed in 1982 and 1983. These projects were successful in treating more than 700,000 acres of defoliated and threatened trees with 364,308 gallons of chemical and biological insecticides. These treatments will reduce volume losses in the affected stands by an estimated 350 million board feet over one rotation. In addition, the 1983 project has been called the largest of its type, involving 19 contractor helicopters and 9 Forest Service contract helicopters. That project treated 524,561 acres.

Initial survey results indicate that the current defoliation has expanded another 700,000 acres over last year (1982). This is a 44 percent increase.

(The Greensheet—October 14, 1983)
USDA Forest Service Region 6
Portland, Oregon

Budworm decline predicted.—Nova Scotia forests were hit hard by the spruce budworm this year, but infestation is expected to decline in 1984, Canadian Forestry Service officials said recently.

The service told a meeting of government and industry officials the pest defoliated 357,600 hectares of forest land this year, compared to 211,800 hectares in 1982.

Don Eldridge, deputy minister of lands and forests, said destruction in Cape Breton was widespread and trees in Cumberland County are dying.

(Daily Gleaner—October 5, 1983)
Fredericton, New Brunswick

Budworm plan 'backfired.'—The budworm salvage program has "backfired," provincial lands and forest minister George Henley said in an interview Friday.

The program led to the storage of more than 400,000 cords of damaged pulpwood from crown land in the Cape Breton Highlands for later use by Nova Scotia Forest Industries.

Breaking a self-imposed silence on issues before the province's Royal Commission on Forestry, Mr. Henley said experts originally believed private woodlots in the lowlands would escape the budworm epidemic.

"It has sort of become a millstone around our neck because under the terms of the contract, the company is extracting the wood that we have stored in the highlands at the expense of the wood that could come in from the private sector, which now is suffering the same fate as the highlands." Mr. Henley said.

The budworm has decimated many lowland woodlots and private owners have been calling for

a reduction in the amount of wood NSFI draws from storage each year or expansion of the salvage program to include private woodlots.

"They have my sympathy, but I'll be quite frank right now—I couldn't express any solution for it except I know that we have a surplus of wood on hand," he said.

The over supply is expected to last for another five years, he said.

(Chronicle-Herald—October 3, 1983)
Halifax, Nova Scotia

Recent Publications

Supplement 3 of the *Spruce Budworms Bibliography* has been published as Maine Agricultural Experiment Station Miscellaneous Report 292. This 59-page document lists about 500 new references to the budworms literature. If you have been receiving other editions of the *Bibliography*, *Supplement 3* should have reached you by the first of November. To obtain a copy, write to Fred Knight, Nutting Hall, College of Forest Resources, University of Maine, Orono, ME 04473.

Also available from the Orono address is "Spruce Budworm Growth Impact Study 1981 Report," by T. B. Brann, G. A. Reams, and D. S. Solomon. This 73-page handbook is Maine Agricultural Experiment Station Miscellaneous Report 287.

Silviculture fans will be interested in Bob Frank's article "Balsam fir (*Pinaceae Abies balsamea*) silvics, silviculture and natural regeneration methods." This piece appears in the 361-page *Proceedings, Silvicultural Guides Workshop, Chippewa and Superior National Forests*, published in 1983 by the Forest Service. A limited supply of free copies is available from the Forest Supervisor, Superior National Forest, Box 338, Duluth, MN 55801.

Until CANUSA's automated egg-mass counter is perfected, the people in charge of egg-mass surveys will have to deal with the tedious job of counting egg masses by hand. But it has been established that nobody counts those masses with complete accuracy. The Gary Simmons team at Michigan State University has written a short article on adjusting counts to take into consideration this inaccuracy. The 1982 report is "How to Apply Bias Adjustment to Spruce Budworm Egg Mass Counts." It is Information Report 82-11 from the Michigan Cooperative Forest Pest Management Program. To get a copy, write to Gary at the Department of Entomology, Michigan State University, East Lansing, MI 48824.

From the same address, you may request "Spruce Budworm Technology Transfer in the Lake States: Results of the Needs Assessment of Forest Managers," by Randy Rogan, Gary Simmons, Bruce Montgomery, and John Witter. This report documents a Lake States survey of pest managers that the Michigan Cooperative Forest Pest Management Program undertook in 1982. The results of the survey were presented to CANUSA-East authors of the management manual at the May 1983 East Lansing meeting. Ask for Technical Report 82-8.

The Eastern Spruce Budworm Council has released "A Review of Entomological Survey and Assessment Techniques Used in Regional Spruce Budworm, *Choristoneura fumiferana* (Clem.), Surveys and in the Assessment of Operational Spray Programs." This publication, by CANUSA cooperators Louis Dorais and Ed Kettela, is a product of the Council's committee for the standardization of survey and assessment techniques. The report is available from the Council's Executive Secretary, Gerard Paquet. Write to him in care of Service d'Entomologie et de Pathologie, Ministère de l'Énergie et des Ressources, 175 rue St. Jean, Quebec, PQ G1R 1N4.

Dave Grimble has given us word of an article by former CANUSA cooperator Nancy Lorimer. "Genetic Means for Controlling Agricultural Insects" has appeared in volume 2 of the *CRC Handbook of Pest Management in Agriculture*. This was published by the CRC Press in Boca Raton, Florida, in 1981. Nancy's article is on pages 299-305.

In August of 1982, Canadian cooperator D. A. MacLean spoke at the International Symposium on Productivity and Stability of Forest Ecosystems, held in Tbilisi, U.S.S.R. His paper was presented in English but will be published in Russian in the Soviet journal *Lesovedenye*. The Maritimes Forest Research Centre is making the English version available to those of us whose Russian is limited to "nyet." For a copy of "Effects of Spruce Budworm (*Choristoneura fumiferana*) Outbreaks on the Productivity and Stability of Balsam Fir (*Abies balsamea*) Forests," write to Margaret Cameron, Canadian Forestry Service, Maritimes Forest Research Centre, P.O. Box 4000, Fredericton, New Brunswick, Canada E3B 5P7.

From the Laurentian Forest Research Centre, 1080 Route du Vallon, Sainte-Foy, Quebec G1V 4C7, you may request a copy of this journal article

Blais, J. R. "Trends in the frequency, extent, and severity of spruce budworm outbreaks in eastern Canada." Can. J. Forest Res. 13(4): 539-547.

And from the Maritimes Forest Research Centre, P.O. Box 4000, Fredericton, N.B. E3B 5P7, the following journal article and Information Report are available:

MacLean, D. A., and D.P. Ostaff. "Sample size – precision relationships for use in estimating stand characteristics and spruce budworm caused tree mortality." Can. J. Forest Res. 13(4): 548-555.

Varty, I.W., and M. E. Godin. 1983. "Identification of some factors controlling aerial spray efficacy." Information Report M–X–142.

In the Hopper

At presstime (mid-November), our hopper runneth over. CANUSA's first USDA series handbook, "Regional Evaluation of B.t. for Spruce Budworm Control," was shipped early this month to Broomall, Pennsylvania, for delivery from the Northeastern Forest Experiment Station. To receive a free copy, send a request for Agriculture Information Bulletin No. 458 to the Station, 370 Reed Road, Broomall, PA 19008.

From CANUSA-East, the following handbooks are in the typesetting-layout-printing phase: "Techniques for Monitoring the Environmental Impacts of Insecticides on Aquatic Ecosystems," by Paul Adamus (Agriculture Handbook No. 613); "Using Computer Simulation to Evaluate Mechanized Harvest Systems," by Dennis Bradley (Tech. Bull. 1687); "Planning Insecticide Application and Timber Harvesting in a Spruce Budworm Epidemic," by John Dimond and others (Agric. Handb. No. 618); "Techniques for Measuring Early-Larval Dispersal of Spruce and Jack Pine Budworms," by Dan Jennings and others (Agric. Handb. No. 614); "Insecticides for Control of the Spruce Budworm," by Bruce Montgomery and others (Agric. Handb. No. 615); "Guidelines for the Operational Use of B.t. Against the Spruce Budworm," by Ozzie Morris and others (Agric. Handb. No. 621); and "Spruce Budworm Parasites in Maine: A Reference Manual for Collection and Identification of Common Species," by David Tilles and Norman Woodley (Agric. Handb. No. 616).

Last, but not least, "Managing the Spruce Budworm in Eastern North America" is also out for typesetting. It has been assigned Agriculture Handbook No. 620.

Steve Sinclair and Douglas Barnes have provided the text and tables (56!) for their long-awaited book on balsam fir utilization. With 94 pages of typescript and 27 figures, this book tells you more about balsam fir than you ever wanted to know, to paraphrase Dorothy Parker. "Balsam Fir: Its Properties and Utilization" will go out for Washington Office Staff review shortly, and we expect publication to take place early in the summer of 1984.

Also at the Staff review phase is Bob Marty's "Guide to Economic Evaluation of Spruce Budworm Management Opportunities." This manual supplies some nuts-and-bolts formulas for figuring out when spraying for budworm is cost effective.

CANUSA-West has given us these manuscripts: "How to Protect Individual Trees from Western Spruce Budworm by Implants and Injections," by Richard Reardon; "Lepidoptera Associated with Western Spruce Budworm," by Dick Stevens and others; "Ground Spray Techniques to Reduce Damage from Western Spruce Budworm," by Larry Stipe; and "How to Distinguish Between Old and New Egg Masses of the Western Spruce Budworm," by Dan Twardus and Val Carolin. All texts are presently in the Washington Office and USDA reviewing stages and will be published in the first half of 1984.

December 31, 1983, was the target date for submission of the three western management manuals—"Western Spruce Budworm," "Managing Trees and Stands Susceptible to the Western Spruce Budworm," and "Western Spruce Budworm and Forest Management Planning." Authors and Program Management met early in November for a group critique of the texts of all three books. Though the publication schedule is hectic, the westerners expect to meet their deadline. Publication should occur in the summer of 1984, and the texts of these books should be available in preprint form for use during the technology transfer meetings early in 1984.

To get more information or to have your name added to the mailing list for the *Newsletter*, contact:

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